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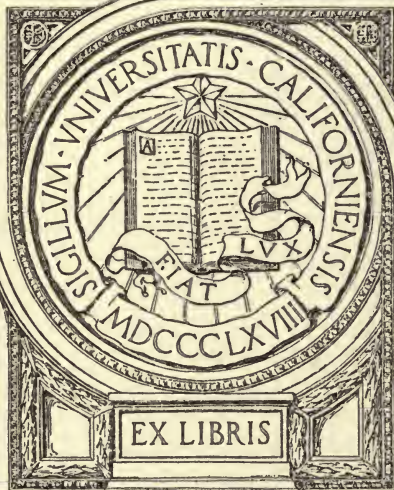


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NATURE STUDY

IN THE
LOS ANGELES
STATE
NORMAL

BY B. M. DAVIS

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NATURE STUDY IN THE LOS ANGELES STATE NORMAL

While nature study is conceded as a necessary part of the common school curriculum, it must be admitted that in practice much of it falls far short of what is expected.

Indefiniteness of plan, disregard of natural interests of children, repetition of topics from grade to grade, and above all the lack of insight of the teacher as to the real aims and purposes of the subject, are responsible, in part at least, for this failure.

The following synopsis of the nature study done in the training school of the Los Angeles State Normal, represents the progress made so far toward a solution of the difficulties just indicated, and an attempt to put the subject on a better pedagogical basis. No claim is made that the principles outlined or the course of study based upon them represent a final solution of the problem, but simply what is in actual operation in this school. It will continue to be revised and subjected to the most severe tests of ordinary school conditions.

Synopsis.

I. THEORETICAL BASIS.—(I, 2, 6, 7, 16, 17).*

(a.) Environment being twofold, physical and social (that of civilization), both must be considered. As civilization advances less attention may be paid to the first but we are not ready to neglect it now, for the instincts formed during the race's complete dependence on nature are still strong.

(b.) One of the chief aims in education is to give to the individual power to adapt himself to his environment. This adaptation does not depend so much upon the child's early training in special lines as satisfying certain natural tendencies. These tendencies or instincts are what the race has found necessary to fit into environment, hence must be considered in the present environment. The love of nature is probably one of the strongest instincts of the child during the ages from four to ten. (I, 2.)

(c.) From the preceding it follows that the subject as related to

* Numbers refer to References.

schools is valuable in proportion to the opportunities out of school to secure contact with nature. It must not be taken for granted, however, that the subject should be neglected in favored localities. In such places the natural advantages should be made the most of. The country child should realize his opportunities so that he may appreciate his surroundings.

(d.) The problem in the early school years of the child is to bring into his life as much of nature as possible. In carrying out this greater aim, the lesser ones, such as habits of observation and interpretation, power of expression, etc., will be gained.

(e.) Nature work has its greatest value in the kindergarten and early primary years, but is valuable in later years in furnishing an acquaintance with and understanding of the common things of nature, and the power to interpret them.



II. PURPOSES OR AIMS. (Definitely stated.)

(a.) Fundamental, satisfying natural interests, thereby giving basis for accessory development. (I, 2.)

(b.) Character building, considering character in the sense of being the adaptation of an individual to his physical and social environment. The best adaptation not only secures the immediate but provides for the future. The latter can only be done by the individual giving something to his environment, whether physical or social. (e.g. Caring for animals and plants.) (I, 7, 17.)

(c.) General culture. (I, 3, 4, 5, 10, 11, 13, 14.)

1. Knowledge of the things of nature which all should know.
2. Training which may form a basis for future studies in pure science, or application of science methods.
3. Experiences which may be useful in interpretation and production of literature.

III. APPLICATION OF ABOVE.—(All of II.) Three general lines of procedure.

(a.) Bringing into the child's experience as many things as pos-

sible in the school room directly, and outside by means of reports and collections.

(b.) Co-operative study of the natural environment of the school, where the teacher organizes and directs the work.

(c.) Caring for animals and plants, utilizing the industrial or human relations to nature. (e.g. The cow as a milk producer, dairies, etc. (I. 8.)

IV. SELECTION OF MATERIAL.—Two objects to be kept in view, viz:—natural interests of the child at different ages, and availability of material.

(a.) Interests. (I, 12, 15, 17.)

“Attributes such as form, size, color and structure, which are usually emphasized in science lessons have very little interest to the child, while motion and use have very great attractions.” (I,1.) The animal as a moving object to secure and play with seems to attract the child at first. Soon is added to this a desire to find out what it does. When this great object is reached, aside from interest in movements, the child is ready for something else. The spirit of competition may be used to advantage in many ways in all grades. (e.g. In securing specimens and in garden work.) (I,7.) Tendency to collect things should be made the most of. In the fifth and sixth grades group activity may be secured by forming naturalist’s clubs. (I, 16.)

(b.) Material. Chief source of material is in the immediate environment of the school. The material at hand is used, for it is most easily obtained and cared for. The outdoor studies center around the garden work. The studies of animals and plants in field excursions, and in the class room are expected to stimulate observation out of school hours. All outside experiences are used so that the pupil may put a value on them, and have a desire to increase them. Other things being equal, the material is always selected which will conform to the general aim of the subject. (II, a, b, c.)



V. METHOD.—(All of II.) General method has already been indicated. Nature study differs somewhat from other subjects in having two phases of presentation, requiring different methods.

(a.) Observation. The child must gain his experiences from actual contact or close observation. He must be led or directed in such a way that the great facts of whatever is observed may be seen and appreciated, and not covered up in a mass of details. Usually the child naturally selects, as his center of interest, the most important characters. The questions which arise should be answered by the object itself as far as possible.

(b.) Recitation. The basis of the recitation is what has been previously observed. All points relating to the subject should be recalled by the pupil and definitely expressed. The recitation should stimulate accurate and extended observation, so that the pupil may use his time better when new material is taken up.

VI. FACTS TO BE KEPT IN MIND IN HANDLING MATERIAL IN OBSERVATIONS OR RECITATION.*

"Nature study has largely to do with the relations of things."
(I, 14).

1. To the whole of which the object is a part.
2. To natural environment.
3. To past and future.
4. To other individuals, similar or otherwise.
5. To cause and effect.
6. To man.
7. To Creator. Natural laws.
8. To other school work.

Recognizing that the chief interest is not in the structure but activities of animals and plants, the following is suggested :

ALL LIVING ORGANISMS ARE AT WORK AND ALL ARE DOING (each in its own way) THE SAME KIND OF WORK, viz :

- (a.) Its own support.
1. Nutrition (food and oxygen).

* These suggestions are expected to help teachers in preparing lesson-plans by keeping the great facts of animals and plants before them.

2. Protection (enemies, etc.)

(b.) Production and care of organisms like itself.

ANIMALS.—(III, 27, 28.) The animal body must be adapted to secure the essentials of life for itself and young in its particular environment. With some, this region is extremely limited, because the animal is adapted to conditions which have a very restricted area. (e.g. Even or uniform temperature, water, etc.) These adaptations may be classified as follows:

1. Food securing. 2. Air securing. 3. Self protection. 4. Rivalry. 5. Defense and care of young. 6. Surroundings.

1. In *getting food* two things must be considered.

(a.) Nature of food, and how secured or captured. (e.g. If the food of a certain animal consists of roots of plants, it must be able to dig them up, or make burrows to reach them. After reaching them the teeth and jaws must be adapted, to breaking them off.)

(b.) How food is managed after being secured i.e. whether disposed of at once and how (by teeth or other means) or stored up for future use.

2. The adaptations for *securing oxygen* are easily determined. If from air, by means of lungs or air tubes; if from water, by means of gills.

3. The animal may *protect itself* in any of several ways, or by a combination of all or part of these.

(a.) Hiding, using some means of shelter, either from view or from direct attack of the enemy.



(b.) Defending itself by inflicting some injury on enemy, as biting, stinging, etc.

(c.) Running away, and thus escaping.

(d.) Imitating in color or form its surroundings in such a way as not to be seen.

(e.) Imitating some animal known to be dangerous.

(f.) Being provided with protective armor which successfully repels attacks.

(Often the same adaptations which will secure protection will also help in securing food.)

4. *Rivalry* among members of its own species, (e.g. brilliant plumage of certain male birds.)
5. The animal *must care for its young*. In general this care depends upon the individuals in the family. An interesting way to consider this subject is to study the life histories of animals. In many cases this is possible. The same questions as to food, oxygen, enemies, etc., are to be noted in study of the care of the young, except that the parent may provide for all or part of the essentials for existence. (Egg, scale insect, ants, kangaroo, etc.)
6. Animals must adapt themselves to their *surroundings*. Some of the factors are seasons, climate, water, dryness, etc.

SUGGESTIONS FOR STUDY OF INSECTS.

Equipments for the School Room.—(III, 27, 28, 30, 31, 32, 35, 36, 37, 38, 39, V, 77.)

Insect Net.—Made by fastening a hoop eight inches in diameter of No. 8 wire to end of broom handle, and sewing a bag of netting two feet deep to the hoop.

Cage.—A small wooden box with posts extending from corners, (8–12 in.) above the top of the box to support the netting. The box should be partly filled with earth and growing seedlings. The netting should cover the box completely. A paper shoe box makes a very good cage. Collecting-boxes should be small cardboard or cigar boxes.

Poison Bottle.—This is sometimes needed if insects are to be killed and mounted. (III, 36.)

Collecting.—Insects are usually hard to find on account of their protective devices. Each plant should be looked over quietly and carefully. A few plants should be selected and hunted over slowly rather than a great many hurriedly. Examine leaves, bark, flower, fruit, stem and roots, taking note of places and conditions. (II, 21.)



Points to Observe and Study.

Method of getting food from plants. (Jaws, teeth, etc.)

How they deposit eggs, ovipositor, spinning apparatus, etc.

Movements. Wings—Arrangement. If two pairs, arrangement of each. How wings are used in flying. Resting condition, whether spread or not. Character of wings as affecting flight. Compare with birds.

Crawling movements. Legs—Position and attachment. Order of movements. Tracks in dust.

Attack and defense. Color, shell, odors, stings, concealment, etc.

Life History. Changes from egg to adult. These changes may be watched by keeping the larvae and feeding them in the cage.

Table for identification of a few of the common orders. For closer identification see (III, 27, 30, 31, 36.)

A. Jaw-like mouth parts for biting.

B. Two pair of wings, unlike in structure.

c. Outer wings sheath-like and meeting in a straight line; under wings folding in two ways.—Sheath-wings, (Coleoptera.)

cc. Outer wings leathery and meeting in a straight ridge; under wings folding lengthwise like a fan.—Straight wings. (Orthoptera.)

BB. Two pair of wings, alike in structure.

c. With many nerves in the wings.—Nerve-wings. (Neuroptera.)

cc. With few nerves in the wings.—Membrane-wings. (Hymenoptera.)

AA. Tube-like mouth parts for sucking.

B. Two pair of wings.

c. Wings covered with powdery scales.—Scale-wings. (Lepidoptera.)

cc. Wings not covered with scales.

d. Upper wings of uniform texture, with one wing crossing the other in the back.—Similar-wings. (Homoptera.)

dd. Wings plainly of two different textures, with one wing crossing the other on the back.—Dissimilar-wings. (Heteroptera.)

BB. One pair of wings. Two-wings. (Diptera.)

PLANTS.—(IV, 45, 46, 48, 52, 53.)

Flowering Plant. Many parts or organs, but three chief ones:—*leaf, stem and root*, each definitely related to something outside of it. (IV, 52.)

1. *Leaf*.—(Foliage.) On stem always exposed to light, each leaf seeking as much light as possible without danger.

Chief *work* of the leaf to make use of sunlight as power to form starch-like compounds from carbon dioxide (taken from the air) and water (taken from the ground).

Structure. Protecting region (epidermis). Working tissue (green cells). Conducting tissue (veins). Openings (stomata).

Protection against cold, dryness, sunlight, rain, etc., by hairs, thickened epidermis, water storage, movement of leaves, etc,

2. *Stem*.—Great *use* of the stem for leaf display, and its character depends upon the character of the leaves it bears.

Structure determined by its work.

All stems have protecting, growing, conducting, supporting, and food storage regions. Variety due to disposition of these regions.

Types. According to method of supporting leaves, procumbent, climbing (several kinds), floating and erect.

3. *Root*.—Adapted to soil relation, and *work* is to absorb, this depending on surface exposure. Growth near end, and influenced by gravity and water. Many roots used for food storage.

Types.—Underground (the common type), aquatic (adapted for getting free water), aerial (adapted for getting water from air), parasite (adapted for getting water and food from other plants), clinging (modified for support).

Additional points to be kept in mind in the study of plants:

Life History.—If flowering plant, form and parts of seed, mode of dispersal, food supply, stages of germination, disposal of seed-coats in germination, etc.



Environment.—Soil, dry or wet. Character of soil (sand, clay, etc.) Power of soil to retain moisture. Elevation. Exposure to sun and winds. Relation to other plants.

Food.—Adaptation of the plant for getting nourishment from the ground. Character of the roots.

Adaptation for getting sunlight. Character of the stem as regards leaf display. (Erect, climbing, etc.)

Arrangement and shape of the leaves. Structure of the leaves in regard to protection from too much sunlight, or too free transpiration. Relation of this structure to the plant's ability to thrive under various conditions. Effect of dry weather on plant.

Enemies.—Plant enemies (rusts, mildews, etc.) Animal enemies, means of protection from. Relation to man. Useful or harmful. If harmful (a weed) points that make it so (rate of growth, reproduction, etc.)

Reproduction.—Two methods. 1. Vegetative (ordinary growing process). 2. Special bodies (spores of lower plants and seeds of flowering plants).

SUGGESTIONS FOR THE STUDY OF FLOWERS.

Purpose of the flower twofold: (a.) Secure pollination. (b.) Protect the developing seed. (IV, 52.)

(a.) Pollination. This means the transfer of pollen, usually from the pollen sacs of the flower to the stigma of another, sometimes to its own stigma. When this is done, certain changes begin in the ovary of the flower whose stigma receives the pollen, resulting ultimately in the formation of the seed. Without this process (pollination) no seed can be formed. To secure pollination is the first problem of the flower. There are almost as many ways of working it out as there are kinds of flowers. Two means of transfer of pollen are available—wind and animals (chiefly insects.)

1. *Wind*.—When this method is used the following adaptations are necessary: a. Plants or flowers must be close together. b. Large amount of pollen. c. Large expanse of stigma. (Illustrated by the oats, wheat, pine, etc.)

2. *Insects*.—Three adaptations. a. Prevention of self-pollination.

b. Securing visits from desirable insects. c. Preventing visits from undesirable visitors.

(a.) Prevention of self-pollination.

The dangers of self-pollination arise only in flowers that have both stamens and pistil. The stigma of the pistil is said to be mature when it has upon it a sweetish, sticky fluid which holds the pollen. Unless the stigma is in this condition the pollen will not cause development of the seed in the ovary of the pistil. The pollen is mature when it is shedding or ready to fall from pollen sacs. There are many devices for preventing pollination, but most of them may be included in three general methods:

1. Position, (flower so constructed as to be impossible for the pollen to reach its own stigma.) 2. Consecutive maturity, (pollen and stigma maturing at different times.) 3. Difference in pollen.

(b.) Cross-pollination by means of insects:

Some inducement must be offered, such as nectar, pollen, or, in some cases, shelter. Color and odor serve as guides to location of flowers. The flower must be so constructed as to compel the insect to touch the pollen in one flower and rub some off on the stigma of the other. Each flower has its own way, hence the variety.



(c.) Undesirable insects. Only flying insects are useful, but crawling insects are attracted. Some of the adaptations for keeping them away are—hairs, glandular secretions, water reservoirs, movements, milk or glue, structure of flower, bloom, position of flower, etc.

(b.) Protection of developing seed.

In general the developing seed is protected in two ways by mechanical means such as the plant protects itself with (thorns, etc) or chemical, having the part around the seed bitter or poisonous. All parts of the flower, which are concerned in pollination alone and do not help protect the growing seed, drop off or wither.

VII. GENERAL OUTLINE OF COURSE IN NATURE STUDY THROUGH EIGHTH GRADE—(Spring Term 1901). *

Kindergarten. (No specified time.)

Garden work every day. Animals and plants in the rooms for observations in connection with stories. Trips to parks. Children encouraged to bring in anything of interest in nature.

First Grade. (Two twenty minute periods daily.)

Garden work as often as necessary to care for the plants started in the fall. Harvesting of corn, beans, peas, etc. Field lessons after the rains. (II, 19, 23, 25; IV, 47, 51.)

Animal study. (III, 26, 29, 41; V, 78.)

1. Rabbit, squirrel, and gopher. 2. Cow, sheep, and goat. 3. Hen, duck. 4. Frog and tadpoles. 5. Bees, caterpillars, and butterflies.

Stories and poems taken in connection with animal and plant study. General plan in animal study—home, food, and adaptation to environment (mode of life.)

Time taken for observation of any objects of interest at any time.

Correlation with literature and drawing.

Second Grade. (Twenty minute periods daily.) (References same as for First Grade.)

Garden work. Preparation of ground and planting of common vegetables—corn, beans, squash, lettuce, radishes, carrots, onions, etc. Observation on growth and care of plants. Flower and fruit, introduced by study of the orange flower by tracing fruit back to pistil. Idea brought out that the pistil has to do with the fruit, and that the other floral organs are necessary to start the development of fruit.

Animal study.

Horned toad, lizard, turtle. Types of seizers, climbers, waders, swimmers, runners from such birds as owl, parrot, ostrich, sea-gull, pelican, and heron.

Such insects as are brought in by chil-



* Detailed outline only given for the third grade, owing to lack of space.

dren, especial attention given those found in connection with the gardens.

Correlation with literature and drawing.

Third Grade. (Twenty minute periods daily.)

Garden work. Later stages and harvesting of wheat, barley, beets, and other commercial plants.

Plants. "From flower to seed" of available plants on campus, and also the common native plants. Collections made.

Animals. Life history, habits, etc., of toad, frog, and salamander.

Occasional lessons on evaporation, weather, etc.

Correlation with literature, drawing, geography, arithmetic.

DETAILED OUTLINE AND SUGGESTIONS FOR TEACHERS OF THIRD GRADE.*

The work consists of plant and animal study taken together. Ordinarily two periods are given to animal study and three to plant study, but this order is varied to suit circumstances, such as lack of material, etc.

Subjects.

Animal study. (II, 21, 23; III, 26; V, 67, 69, 80.)

Frog and toad, general characters and habits.

Salamander, general characters and habits.

Life history of each.

Review of horned-toad and lizard for comparison.

Such insects as are found in connection with the study of plants.

Plant study. (II, 19; III, 47; IV, 50.)

Garden work. Commercial plants, wheat, etc.

From flower to seed of the most common wild flowers.

Frog and Toad and their Life-histories.

Material, collecting, and preservation.

Collecting.

For this a pail and net (with long handle) will be useful.

Some provision for keeping the feet dry, rubbers or rubber boots.

When to go.

Any time after the 20th of Jan.

* Similar outlines have been prepared for all grades.



Where to go.

Any quiet place where water has been standing for some time. The pools along the Los Angeles river may be reached by taking the Daly street car at the Buena Vista street bridge.

Ponds at the parks at unfrequented parts.

Eggs are usually found in the garden pond.

How to hunt frogs and toads.

No specific directions ought to be necessary for this. They will usually be found along the edges of the pond and will jump into the water when frightened. They will soon come to the top of the water for air, when they may be seen and caught with the net. When caught they should be put in a covered pail or sack, care being taken to give them enough air.

Where to find eggs.

Eggs will likely be found where the frogs and toads are. It may take some careful hunting to find them. They are usually in shallow water near the bank. Frog eggs are in rather large gelatinous masses clinging to sticks or plants. Each egg has in its center a small black or dark spot (the egg proper). See preserved specimens.

Toad eggs are deposited in similar manner, but are distinguished from frog eggs by being in strings, and are not always attached to sticks. See preserved specimens.

As fast as they are gathered they should be placed in water.

Toads—What to do with them.

Places should be prepared for them as nearly like their natural surroundings as possible, and should be covered with netting to keep them from escaping. A dish of fresh water should be in the box. Care should be taken to have the box always clean.



Frogs—They may be kept in the same place as the toads.

Feeding. Both frogs and toads are fond of small living animals such as worms and insects.

Eggs. For the later stages put part of the eggs in the garden pond.

The remainder, not too many, may be put in glass globes. Several should be put in shallow dishes ($\frac{1}{2}$ doz. in each) for individual observation. Care must be taken to keep the water well aerated. This may be done by changing the water frequently or by forcing air into the water by means of a bicycle pump. In all cases the natural pond conditions should be imitated.

Observations. These should be made outside of recitation periods on the animals in the school room. One trip to the garden pond should be made each week to compare with other specimens. The changes are rapid at first but less rapid as the animal grows older.

Things to be observed. Account of number from time to time. It will be found that the number of individuals will gradually decrease.



Some reasons for this decrease—lack of food, lack of air, enemies. What kind? Other causes?

Comparison of rate of growth of those in the pond with those in the school room.

Explanation of this difference, if possible. Does the number of individuals have anything to do with the growth? Under what conditions are the individuals the largest? Smallest? Change in individuals. (Keep record on blackboard.)

Does the little black center change shape?

When does the animal begin to move in the egg?

When does the animal break from the egg? (Hatch.)

What does it do when it hatches?

When does it begin to swim?

What does it do when it is not swimming? (Remains usually fastened by V-shaped sucker to some object.)

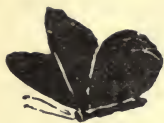
In what part of the jar is it generally located?

Is there any reason why it likes this part of the jar better than the other parts?

Is there any difference in the position of the animals just before and just after giving them air?

Feeding.

They use small plants on the stones (slime) for food. New slime-covered stones should be added from time to time. Examine the stones after they have been in the water with the animals for



some time. They may be fed with fresh meat or coarse meal.

Later changes.

Big heads, legs, disappearance of tail. (Gradually?)

Significance of coming to the top of the water?

(Using new lungs.)

Final transformation. Beginning of life on land.

Along with the study of these transformations from egg to frog or toad, observations should be made on the habits of the frogs and toads which are kept in the room.

Toads.

They may be kept in the way already indicated, being careful to keep the place cool and damp. The vessel holding the animals should be covered with netting or wire screening so that they may be seen easily. Pupils must be quiet while watching the animals. The food consists of any small creeping or crawling animals. These must be alive. Pupils may bring in insects, worms, caterpillars, etc.

Points to be noticed.

Account should be taken of the number eaten in a given time.

These accounts should be repeated from time to time.

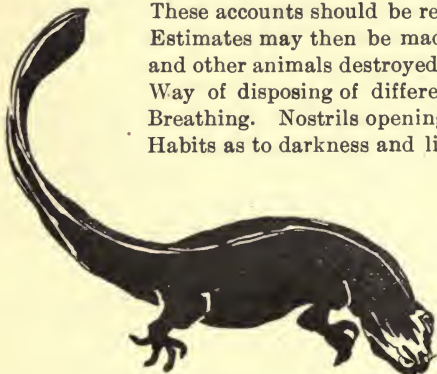
Estimates may then be made of the number of insects and other animals destroyed in a season.

Way of disposing of different kinds of food.

Breathing. Nostrils opening and closing.

Habits as to darkness and light to be observed at home

by as many of the pupils as possible. Encourage the pupils to have one or more toads at home in garden or yard. They will probably remain if put in a damp, cool, shady place where they can hide in day time.



The animals should not be disturbed at first. They must get used to their home and not be handled roughly.

Frogs—They may be kept in the way already indicated. Try the same food as with toads. Observe same points and make comparisons.

Recitations—Whenever necessary the time may be taken to care for the animals without any attempt to teach.

Throughout the whole course or subject the teacher must guide the pupils rather than teach in a formal way. Refer, when possible, to the objects for answers to questions. The recitations should consist in putting together from time to time what has been seen, comparing records of individual pupils, and referring back to the objects to settle undecided questions, putting the final results, if important, on the board. The subjects indicated under points to be observed will afford abundant material. The life history of frog and toad will occupy under favorable conditions about two or three months.

The changes are most striking and rapid in the first and last stages, and therefore should receive the most attention.

Expression.

Drawings should be made from time to time so that the life history may be represented in all forms of expression (oral, written, and by drawings).

General aim.

The general aim is not so much to bring out the different facts *as such*, but to bring the pupils in as natural a way as possible in contact and in sympathy with some of the most common and unappreciated animals. The life of the frog or toad with its struggles, activities, and dangers should be a revelation to inspire a desire for similar knowledge of other forms of animal life.

Salamander.

This animal is related to the frog and toad, and may be kept under the same conditions.

Where found.

In the water in most of the canyons near Los Angeles from Jan-



uary to April. At this time they are swimming in the water, and may be kept in water for several months, but will probably thrive better if put under similar conditions as indicated for frog and toad.

Points to be observed.

General characters—smooth skin, legs, tail, mouth, etc.

Compare with frog and toad.

How does the animal breathe? Watch movements. When in the water does it come to the top to breathe? If so, how often? Look for bubbles of air? What part of the head do they seem to come from?

Watch the animal get food. Feed flies or worms. Put small piece of meat on end of wire or stick and pass several times in front of its mouth. The animal may sometimes be induced to take food in this way.

How does the animal move through the water?

Watch crawling movements on a board.

Compare the two movements.

Other points may be suggested to the teacher as the animals are watched from time to time.

Eggs—These may be found in the streams with the salamanders, about the middle of March. They will be found in small bunches clinging to sticks and weeds in much the same way as the eggs of frogs. See preserved specimens.

How taken care of.

Same as the eggs of frogs and toads. The development is much slower. They may be seen moving about in the egg long before they hatch. After hatching they may be cared for in the same way as the tadpoles of the frog and toad. The time of complete change into adult animals will be several months (6-9).

Points to be noticed—Same as frog and toad. Compare.

The gills of the young salamander are not covered as in the tad-



poles, but may be seen as a fringe around the head. The general suggestions about the frog and toad will apply in the study of the salamander and its life history.

Garden Work.

This consists of occasional observations on the commercial plants which were planted during the previous term, and taking care of them when they are ready to be harvested. In connection with this some time may be given to the methods in actual use on the



California ranch in harvesting and caring for the products such as wheat, barley, beets, etc.

Plants.

The object of this study is to get acquainted with the common wild plants, both native and introduced. This object includes the recognition by means of flower, and as far as possible by other characters such as leaves and seed. As each plant is studied not only are its general characters observed, but as far as possible the adaptation of its flowers to secure pollination.

Method—No specific directions can be given here. The teacher must select some of the main facts about the plant and see that the pupils observe and describe them. The real test is whether the child can recognize the plant and recall the name, or if the name is given to be able to select the plant from among others. Such information as is necessary for the teacher's preparation may be obtained from the references.



Collecting and caring for specimens. As far as possible have the children bring in their own specimens. Those plants in the immediate vicinity of

the Normal may be gathered by the class in field lessons. Each pupil should preserve and mount a specimen of each plant studied. These specimens, when finished, will furnish material for review.

Fourth Grade. (Three twenty-five minute periods per week.)

Garden work. Cultivation and study of some members of the Nightshade family of plants. (IV, 50.)

Plants. Review of some of the common California wild flowers. Some of the common types of lower plant life. (Ferns and their allies, mosses and liverworts, algae and fungi. (IV, 45, 46, 52.)

Animals. Common forms of animal life found at the sea-shore (not studied the previous term, insects (after cray-fish, crab, etc.) spiders, etc. (III, 26, 27, 30, 34, 36, 39.)

Correlation with literature, drawing, geography, manual training.

Fifth Grade. (One forty minute period per week.)

Plants. Continuation of the study of the work of plants begun in the fall. Adaptations, (climbing, etc.)

Experiments in fermentation.

Correlation with literature, drawing, geography, arithmetic.

Sixth Grade. (One forty-five minute period per week.)

Time devoted to meetings of Junior Naturalists' Club.

Seventh Grade.(*) (One forty minute period per week.)

Discussions (with experiments and home readings) of simple phenomena of light and electricity. Construction of voltaic cell, galvanometer, and induction coils. Study of great men in history of physics:—Franklin, Faraday, Edison, Field, Morse, et al.

Eighth Grade.(‡) (One forty minute period per week.)

General study of air based on laboratory work on oxygen, nitrogen, carbon dioxide, watery vapor, smoke, etc.

Application of truths learned in explanation of combustion, animal and plant life.

Physiology.—In addition to the subjects indicated in the above outline such phases of the subject of physiology as are adapted to the different grades are selected and presented. These pertain chiefly to the care of the body, formation of habits, etc.

* Outlined by Dr. Schults. ‡ Outlined by Mrs. English.

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